


Benefits of the Duchenne Smile and Positive Emotions. A Systematic Review

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Abstract

Keywords:

Duchenne smile, genuine smile, positive emotion

The Duchenne smile is the genuine smile characterized by the activation of the muscles around the eyes and mouth. It has been associated, in the specialized literature, with the experience of positive emotions. Through the present work, using a qualitative approach, we aimed to identify and systematize the studies carried out in the period 2010-2023 that investigated the relationship between the Duchenne smile and positive emotions. Following the application of specific keywords, 611 studies were identified, from which, after applying the inclusion-exclusion criteria, 8 studies were included in the review. A conclusion could not be drawn regarding the idea that the Duchenne smile is indisputably an indicator of positive emotions, but the data provide us with important information such as the following: the Duchenne smile is associated with experiencing positive emotions (happiness, joy, hope, contentment) and manifests itself in the context of affiliation and cooperation. It has an important role in triggering extended cognitive states (attentional ones) and can be performed voluntarily (in the presence/absence of a positive emotion), having the same health benefits as spontaneous smiling. In addition, the Duchenne smile increases the acceptance rate of feedback given by teachers in class. The relationship between the Duchenne smile and positive emotions is context dependent.

Zusammenfassung

Schlüsselworte:

Duchenne-Lächeln, ehrliches Lächeln, positive Emotionen

Das Duchenne-Lächeln ist das echte Lächeln, das durch die Aktivierung der Muskeln um Augen und Mund gekennzeichnet ist. In der Fachliteratur wird es mit dem Erleben positiver Emotionen in Verbindung gebracht. Mit der vorliegenden Arbeit wollten wir mithilfe eines qualitativen Ansatzes die im Zeitraum 2010–2023 durchgeführten Studien identifizieren und systematisieren, die den Zusammenhang zwischen dem Duchenne-Lächeln und positiven Emotionen untersuchten. Nach Anwendung spezifischer Schlüsselwörter wurden 611 Studien identifiziert, von denen nach Anwendung der Einschluss-/Ausschlusskriterien 8 Studien in die Überprüfung einbezogen wurden. Es konnte keine Schlussfolgerung hinsichtlich der Vorstellung gezogen werden, dass das Duchenne-Lächeln unbestreitbar ein Indikator für positive Emotionen ist, aber die Daten liefern uns wichtige Informationen wie die folgende: Das Duchenne-Lächeln wird mit dem Erleben positiver Emotionen (Glück, Freude, Hoffnung, Zufriedenheit) und manifestiert sich im Kontext von Zugehörigkeit und Kooperation. Es spielt eine wichtige Rolle bei der Auslösung erweiterter kognitiver Zustände (Aufmerksamkeitszustände) und kann freiwillig durchgeführt werden (bei Vorhandensein/Fehlen einer positiven Emotion) und hat die gleichen gesundheitlichen Vorteile wie spontanes Lächeln. Darüber hinaus erhöht das Duchenne-Lächeln die Akzeptanz des Feedbacks der Lehrer im Unterricht. Der Zusammenhang zwischen dem Duchenne-Lächeln und positiven Emotionen ist kontextabhängig.

1. Introduction

The Duchenne smile has been the subject of much research, especially in recent years since positive psychology has seen considerable development. The diversity of research on the Duchenne smile and the domains in which it has been investigated (e.g., in the field of emotions and facial recognition, the field of social interactions, the neuro-physiological field, etc.) have contributed to understanding the depth of this concept and the importance that it can have in people's lives. The researchers' concerns focused on how people perceive the Duchenne smile and the differences in perception between them, its relationship with health, well-being in general, but also in establishing to what extent a Duchenne smile can or cannot be faked. One of the hypotheses most

used in research is the one that states that the Duchenne smile is an indicator of positive emotions. The Duchenne smile is the spontaneous smile, the smile with "mouth to ears", the smile that can hardly be faked, the smile that activates the muscles around the eyes and mouth, the smile that is associated with experiencing positive emotions (Ekman et al., 1990; Frank & Ekman, 1993). The belief that this hypothesis is true has led to the Duchenne smile being used in several studies to identify positive emotions (Abel & Kruger, 2010; Soussignan, 2002) in which various concepts in relation to experiencing positive emotions have been investigated. The most common emotion it has been associated with is that of joy or happiness. On the other hand, there are also studies that have



claimed that the Duchenne smile can be achieved voluntarily (Krumhuber & Manstead, 2009; Krumhuber et al., 2014), can be used as a cultural tool (Martin, et al., 2017) and that its appearance is also present in the case of experiencing negative emotions (Harris & Alvarado, 2005).

Smiling is associated with the idea of joy or happiness, but to the same extent, smiling can also be used to mask negative emotions such as fear, anger, distress, disgust (Ekman, 2009). It is thus considered to be "one of the most widely used signals used in human communication" (Kraut & Johnston, 1979, p. 1539). One of the reasons why smiling can easily be used to mask other than positive emotions is that it is the most easily voluntary facial expression (Ekman, 2009). Seen as an important tool of social communication, the smile has been classified, in the specialized literature, into several categories. Thus, from the point of view of association or not with a positive emotion, a distinction was made between the genuine, true smile and the fake smile that does not accompany positive emotions (Martin et al., 2017).

The smile typology was determined by calling on different methods. The best known and most used is the Facial Action Coding System (FACS) (Ekman, 2002), through which specialists can identify, based on facial action units, movements of the muscles involved in manifestation of facial expressions. Thus, in the expression of a smile, the action units AU 6 (raising the cheeks) and AU 12 (raising the corners of the mouth) are activated. Starting from this method, programs have been developed to accurately identify the intensity and duration of certain expressions basic facial recognition such as Noduls Face Reader which has only 85-86% accuracy in facial emotion recognition compared to FACS (Cross et al., 2022). Another method used is facial electromyography (EMG) which has the quality of capturing muscle movement at the level of micro-expression that is not visible to the naked eye (Wingenbach, 2022).

The importance of research on smiling is supported by the results of studies that have provided evidence that it has numerous benefits in various areas of people's lives.

People who intentionally smile for one minute a day improve their mood (Neuhoff & Schaefer, 2002). This is of particular importance, as there are studies that have shown that our emotional state has an important impact on the immune system (D'Acquisto et al., 2014). Smiling can therefore have a protective role when people face situations laden with negative

emotionality (Ansfield, 2007). It appears that in mildly depressed individuals, even a short-lived smile has the ability to improve their negative moods in the long term (Lin et al., 2015).

Today, the most widely used indicator that differentiates between genuine and fake smiles is the Duchenne marker, named after the well-known French neurologist, Guillaume Benjamin Amand Duchenne de Bologne (1862). He studied the movement of facial muscles and observed that during the experience of genuine joy, the zygomatic major muscle and the orbicularis oculi contracted, which did not occur during the display of fake joy and an inauthentic smile associated with it (Ekman et al., 1990). The one who coined this type of smile with the name of Duchenne was Paul Ekman (1989).

The Duchenne smile was therefore most associated with joy. Thus, in an experiment carried out by Ekman et al. (1990), this type of smile was displayed more often in the context of viewing pleasant movies than during unpleasant ones, when the comparison was made with other types of smiling. In these contexts, smiling was observed taking into account brain asymmetry measured by electroencephalogram (EEG) and subjects' self-report of their positive emotions. It was thus observed that during the Duchenne smile, the left side of the temporal and parietal region of the brain is mainly activated, the activation of the left temporal side occurring during the experience of positive emotions, but it was not possible to specify what exactly the activation of the parietal region of the brain reflects (Ekman et al., 1990).

On the other hand, it has been shown that the Duchenne smile can be produced deliberately even in the absence of positive emotion (Gosselin et al., 2010). Moreover, some research has found that the Duchenne smile can occur even when negative emotions such as stress, pain, or sadness are experienced (Harris & Alvarado, 2005).

The Duchenne smile is assumed to be an indicator of experiencing positive emotions (Messinger et al., 2001). Researchers have questioned whether positive emotions have the same adaptive purpose as negative ones, which present specific behavioral tendencies useful for survival (David & Szentágotai-Tătar, 2017). Thus Broaden-and-Build Theory (Fredrickson, 2001) emerged as a response to traditional psychology that has paid more attention to negative emotions and their evolutionary role. This emphasizes the effect that positive emotions have, in opposition to negative ones,

on cognitive structures related to attention and thinking, transformations that can further lead to behavioral changes (Ayers et.al, 2014).

Contemporary theories of emotions (Ellis, 1994, apud Dryden & Bond, 1994) claim that subjective experiences, whether positive or negative, are not generated by the life events we face, but by the way we evaluate them, either consciously or unconsciously, giving them a certain meaning, emotions being able, in turn, to be evaluated and give rise to other emotions (David & Szentágotai-Tátar, 2017).

2. Methodology

To carry out the systematic review, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology was used, which, although initially developed for research in the medical field, was also successfully used in the field of psychology (Bolier et al., 2013, apud. Tay et al., 2021).

An online literature search was conducted using two databases, Springer Link and Web of Science. These databases were chosen after analyzing their functions and content. They have been found to represent data collections that can be used appropriately for this type of approach and research field, compared to others (Gusenbauer & Haddaway, 2020; Walden, 2021).

To refine the research, we used the Boolean search type and created the following key word combinations: ("Duchenne smile" OR "genuine smile" OR "true smile" OR "authentic smile" OR "enjoyable smile") AND ("positive emotions" OR "happiness" OR "joy" OR "gratitude" OR "serenity" OR "interest" OR "hope" OR "pride" OR "amusement" OR "inspiration" OR "awe" OR "love").

To identify the articles, the lexicon corresponding to positive emotions exemplified in the Broaden-and-Build Theory of positive emotions (Fredrickson, 1998) was used. The intention was to review studies that looked at other positive emotions in relation to the Duchenne smile, apart from those that looked at the emotions of happiness and joy.

3. Inclusion-exclusion criteria

We applied three inclusion criteria to identify studies according to the objective of this review.

The first criterion followed the year of publication of the article. We wanted to review articles from the last ten years, to capture what was new on this topic,

but since approximately two years were affected by the Covid 19 pandemic, we included three more years in the research, the final period considered being 2010-2023.

The next criterion considered the inclusion of articles published only in scientific journals, not books, and having a detailed analysis of the results. The third criterion concerned the language in which the article was written and, in this sense, only articles written in English were chosen. Clinical trials, review studies and meta-analyses were excluded. We decided not to include reviews and meta-analyses, since these presuppose the identification of primary research specific to a topic (Pollock & Berge, 2018), or, by selecting them, it would mean using secondary sources of data, and the purpose of our research is not to carry out an umbrella type review (Choi & Kang, 2023). We also excluded studies that addressed the issue of smiling in general, without a clear distinction between Duchenne and non-Duchenne smiles or other types of smiles. In addition, the articles that fall within the scope of dental or aesthetic medicine, and the studies that investigated the perception of the Duchenne smile or the relationship of the Duchenne smile with other concepts, were removed.

The title and abstract of articles were screened to identify relevant articles meeting these criteria. When, after reading the abstract, the article could not be eliminated with certainty, the full text was analyzed.

There were no restrictions related to the number of participants, their age, the type of design.

4. Results

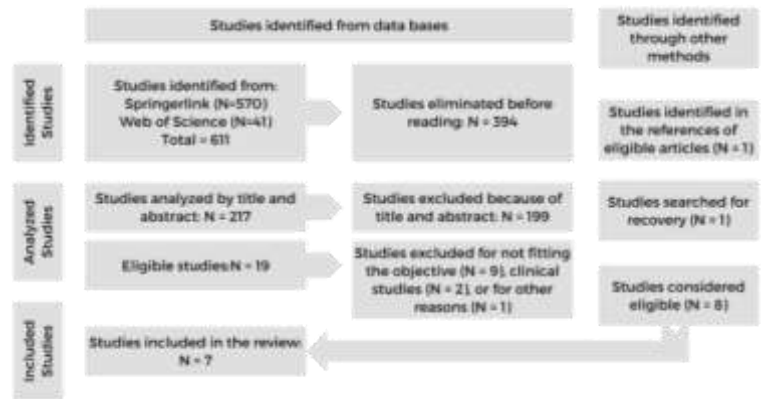
After entering the keywords mentioned above, we obtained a total of 611 studies. After removing duplicates (394), 217 studies remained. 210 studies were excluded because they were either unrelated to the topic or did not meet the eligibility criteria. Another study included in the bibliography of an eligible article was identified and entered for analysis.

In total, 8 studies were fully and carefully analyzed to extract the information necessary for our systematic review. Figure 1 illustrates our approach through the PRISMA diagram. The eight studies are illustrated in Table 1.

Table 1 Synthesis of the articles selected for the narrative review regarding the relationship of the Duchenne smile with positive emotions.

No	Article
1	Campos, B., Schoebi, D., Gonzaga, G. C., Gable, S. L., & Keltner, D. (2015). Attuned to the positive? Awareness and responsiveness to others' positive emotion experience and display. <i>Motivation and Emotion</i> , 39(5), 780–794. https://doi.org/10.1007/s11031-015-9494-x
2	Gunnery, S. D., Hall, J. A., & Ruben, M. A. (2013). The deliberate duchenne smile: Individual differences in expressive control. <i>Journal of Nonverbal Behavior</i> , 37(1), 29–41. https://doi.org/10.1007/s10919-012-0139-4
3	Girard, J. M., Cohn, J. F., Yin, L., & Morency, L.-P. (2021). Reconsidering the Duchenne smile: Formalizing and testing hypotheses about eye constriction and positive emotion. <i>Affective Science</i> , 2(1), 32–47. https://doi.org/10.1007/s42761-020-00030-w
4	Ergül, H. (2023). The case for smiling? Nonverbal behavior and oral Corrective Feedback. <i>Journal of Psycholinguistic Research</i> , 52(1), 17–32. https://doi.org/10.1007/s10936-021-09807-x
5	Tuck, N. L., Adams, K. S., Pressman, S. D., & Consedine, N. S. (2017). Greater ability to express positive emotion is associated with lower projected cardiovascular disease risk. <i>Journal of Behavioral Medicine</i> , 40(6), 855–863. https://doi.org/10.1007/s10865-017-9852-0
6	Johnson, K. J., Waugh, C. E., & Fredrickson, B. L. (2010). Smile to see the forest: Facially expressed positive emotions broaden cognition. <i>Cognition & Emotion</i> , 24(2), 299–321. https://doi.org/10.1080/02699930903384667
7	Mattson, W. I., Cohn, J. F., Mahoor, M. H., Gangi, D. N., & Messinger, D. S. (2013). Darwin's Duchenne: eye constriction during infant joy and distress. <i>PLoS One</i> , 8(11), e80161. https://doi.org/10.1371/journal.pone.0080161
8	Crivelli, C., Carrera, P., & Fernández-Dols, J.-M. (2015). Are smiles a sign of happiness? Spontaneous expressions of judo winners. <i>Evolution and Human Behavior: Official Journal of the Human Behavior and Evolution Society</i> , 36(1), 52–58. https://doi.org/10.1016/j.evolhumbehav.2014.08.009

Figure 1. PRISMA diagram of the search and selection process.



Note: From Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: <http://www.prisma-statement.org/>

5. Discussions

The Duchenne smile is the marker most used in research to identify the experience of positive emotions. However, the question has been raised whether this assumption is correctly used and whether when conducting such studies it is not necessary to take into account the complexity of the context in which a smile appears in general, and a Duchenne smile in particular.

In the review of the specialized literature, we took into account the way in which the Duchenne smile was used and to what extent the authors of the studies showed whether or not it is an indicator of positive emotions. As we have seen, the essential element that differentiates the Duchenne smile from other forms of smiling is the activation of the eye muscles (lat. *Orbicularis oculi*) which produces this expression of raising the cheeks, narrowing the eyes and wrinkling the skin around the eyes (Ekman et al., 1990). Most of the studies identified linked the Duchenne smile to the expression of an emotion of happiness and joy.

However, it appears that this smiling time is also associated with experiencing other positive emotions.

Thus, in the study by Johnson et al. (2010), the occurrence of Duchenne smile during inductions of positive, negative or neutral emotions was investigated. Moreover, the authors, carrying out two experimental studies, wanted to find out to what extent the expansion of the cognitive repertoire as formulated and supported by the Broaden-and-Build Theory (Fredrickson, 2001) can be produced by facial expressions specific to positive emotions. The study used facial electromyography (EMG) as a method to discriminate Duchenne from non-Duchenne smiles, as

an alternative measure that the authors claimed was more valid in capturing emotions not stated in subjects' self-reports (Johnson et al., 2010). It was found that the frequency of Duchenne smiles among subjects was higher during the induction of positive emotions than when they were induced with negative or neutral emotions, and this type of smile also correlated with self-reports of positive emotions, such as hope and contentment. In addition, the study showed that the frequency of the Duchenne smile was associated with attentional expansion, in a task of global processing of visual stimuli, self-reports of positive emotions expressed also at the facial level, being predictors in this regard.

Given these results, however, we ask whether the Duchenne smile can be deliberately produced and, when it is, to what extent does it still express positive emotion? In this sense, the study by Gunnery et al. (2013) investigated the extent to which people can voluntarily produce a Duchenne smile in different social situations and if there are individual differences in the ability to voluntarily produce this smile, the experimental procedure took care to minimize the effect of emotional and motivational factors. Subjects participated in two types of tasks: a role-play task, designed to measure the use of the deliberate Duchenne smile in simulated social situations, and an imitation task, designed to measure the ability to produce the Duchenne smile. The results showed that some of the participants were able to deliberately produce a Duchenne smile in both tasks, which indicated that such an expression of a positive emotion can be deliberately achieved without the positive emotion being experienced.

And in another study included in the review (Girard et al., 2021), the authors reconsidered the Duchenne smile hypothesis regarding the fact that it is a specific indicator of genuine positive emotion. The authors formulated and tested alternative hypotheses, the results being the following: the hypothesis that the Duchenne smile is triggered by positive emotions was supported, 90% of the smiles produced while experiencing a positive emotion involved narrowing the eyes.

Although eye constriction was the main indicator by which positive emotions were differentiated from negative ones, however, the presence of this marker explained only 27% of the variance of self-reported positive emotions and only 32% of smile intensity. It was thus shown that other dimensions such as smile intensity and duration were better predictors of the

presence of positive emotions when eye muscle movement was controlled for.

If the Duchenne smile can be produced voluntarily and can have a role in social interactions, it remains to be seen to what extent the same deliberate Duchenne smile can have the benefits that arise from the association of spontaneous smiling with positive emotions.

In this sense, in the study by Tuck et al. (2017) the Duchenne smile was used as an indicator of the ability to express positive emotions. More precisely, the subjects deliberately expressed ten basic emotions, including that of happiness, the Duchenne smile being identified by a special software that scores the expressiveness according to the contraction of the facial muscles, then calculating a positive expressiveness score. After applying statistical analyzes to test the associations between this score and other variables measured in this study (demographic data, atherosclerotic cardiovascular disease risk score, emotion scale score, depression scale score, loneliness and emotional intelligence) the authors found that positive emotionality and the ability to voluntarily express positive emotions were associated with reduced risk of cardiovascular disease (CVD), even after controlling for variables such as loneliness, depression, and trait positive emotionality. These results are consistent with those of an older study that showed that regardless of whether an emotion is experienced or not, the ability to deliberately express it reduces the risk of CVD (Kraft & Pressman, 2012).

The study by Campos et al. (2015), even if its main theme was to examine human emotional receptivity in different social situations, it was chosen for analysis because it aimed at the production of positive emotions in these contexts, their identification being achieved both by coding the manifested Duchenne smiles, by Facial Action Coding System (FACS), as well as in relation to the participants' self-reports of their experiences. The authors demonstrated that people are aware and responsive to others' emotions when there is an opportunity for commitment in a future relationship (Campos et al., 2015).

The results showed that the subjects were more receptive to the positive emotions accompanied by the Duchenne smile of others, compared to the positive emotions that were not accompanied by this type of smile. Only positive emotions (particularly amusement) that displayed a Duchenne smile were predictive of subsequent closeness between two strangers.

Based on the same argument as the one for which I chose the previous article in the review, I also included for analysis the studies of Crivelli et al. (2015) and Ergül (2021).

Thus, the study conducted by Crivelli et al. (2015) analyzed the controversy between Basic Emotion Theory (Ekman & Friesen, 1969; Izard, 1971; Tomkins, 1962) and Ecological Behavioral Theory (Fridlund, 1994) whose assumptions we discussed in the introductory part of this paper. The authors observed the facial expressions of judo players in two contexts: winning a match in a national junior championship and instant victory in an international competition. The second approach was carried out to verify the results of the first study, in a more diverse cultural context. Both situations had a high potential for generating positive emotions.

What was predictive for the appearance of the Duchenne smile was the moment of interaction of the athletes (inferred from the movements of the arms and hands in contact with the audience), this result coming in support of the Behavioral Ecology Theory that sees the smile as a tool of social interaction, and not an expression of basic emotions (Fridlund, 1994).

Last but not least, the study conducted by Ergül (2023) aimed to find out how often teachers smile while giving students corrective feedback during classes and whether the smile used is a genuine one. Moreover, it was investigated to what extent the genuine smile is a factor that can influence the effectiveness of the corrective oral feedback. The results showed that 64% of the smiles used by the teachers during the corrective feedback were genuine. Furthermore, when the genuineness of the smile was taken into account it was found that the acceptance rate of student feedback increased by 69.4%, with genuine smiles significantly correlating with corrective oral feedback compared to polite smiles (Ergül, 2023).

The last study selected for our analysis investigated whether the Duchenne marker represents the facial expression that signals both positive and negative emotions in infants during parent-child play using the face-to-face and still-face (Face-to-Face/Still-Face [FFSF]) (Mattson et al., 2013). The results of the study confirmed the hypothesis formulated by Darwin according to which the constriction of the eyes in babies is associated either with more positive smiles or with a more negative expressiveness of crying. Thus, the smile accompanied by the narrowing of the eyes is more intense and appears more often in situations that cause

positive emotions, than the simple smile, which does not involve the constriction of the eyes. The study also aimed at highlighting the role of eye constriction in the emotional expressiveness of crying, in the inert face condition of the mother and in a real distress situation, namely the vaccination of children. As the authors of the study also concluded, in infants, the Duchenne smile signals the presence of a strong positive emotion, but at the same time a Duchenne-type expression can also indicate a negative emotion in their case.

Is the Duchenne smile an indicator of positive emotions? In an attempt to answer this question, we selected and analyzed for the narrative systematic review the studies in which the production of Duchenne smiles either took place during the experience of spontaneous positive emotions caused by certain natural life situations, or appeared during the induction of positive emotions in laboratory or experimental situations. Articles that only investigated the idea of perception and interpretation of these smiles in different contexts without actually producing the Duchenne smile, whether deliberate or not, were removed. On the other hand, some of the present studies did not entirely lack the investigation of Duchenne smile perception, but since measuring the frequency of smile production was one of their themes, they were also taken into analysis.

Based on the results of these studies, we cannot yet draw a clear conclusion regarding the idea that the Duchenne smile is an indisputable indicator of positive emotions, but the data provide us with important information such as the following: Duchenne smile is associated with experiencing positive emotions in general, with those of happiness and joy, in particular. However, the present studies have shown that this time of smiling is also found when emotions such as hope and contentment are experienced.

In addition, the Duchenne smile also occurs during the experience of emotions that are manifested in the context of affiliation and cooperation. Also, this type of smile has an important role in triggering extended cognitive states, without knowing the exact mechanism in this regard.

On the other hand, emotions such as pride and awe were not associated with the Duchenne smile, but on the contrary, with the non-Duchenne smile. What has also been established in both the present and older studies is that the Duchenne smile can be produced voluntarily, either in the presence or in the absence of positive emotion, especially in tasks that do not

involve more complex cognitive processing (e.g. when participants are asked to imitate a smile, as opposed to having to do so in a role play). Voluntary Duchenne smiling may provide the same health benefits as genuine smiling, individuals who have a good ability to voluntarily express such smiles are likely to have emotional self-regulation skills.

Related to the elements that differentiate a Duchenne smile from a non-Duchenne smile and their relationship with positive emotions, it was found that although the constriction of the eyes through the activation of the Orbicularis oculi muscle corresponding to the facial action unit AU6 in the FACS coding system is considered a differentiating element between the two types of smiling, however this expression was also encountered in situations where no positive emotions were experienced. In addition, it appears that intensity is a better predictor of positive emotions.

Taking into account all these corroborated results and data from other older studies, we can say that research is still needed to discover the mechanisms underlying these relationships between the Duchenne smile and positive emotions.

The intensity of the smile must be taken into account in such studies when differentiating between Duchenne and non-Duchenne smiles. Some studies have found in addition to spatial patterns, as considered the Duchenne marker, and temporal properties of emotional expressions that also contribute to the differentiation between a spontaneous and a deliberate smile, being associated with the person's internal states, such as the duration of a smile (Schmidt et al., 2006).

There are authors who recommend that we focus our attention on what a Duchenne smile does rather than what it expresses, without the intention of detracting from the importance of its use for identifying positive emotions, but considering that it is insufficient to evaluate an emotion and label as such (Krumhuber & Kappas, 2022).

A limitation of the present work arises from the fact that the classification of positive emotions carried out by Fredrickson (2013) was used to identify the studies. In the specialized literature, no agreement was reached regarding a standard classification of positive emotions, its use in the search process being possible not to cover the whole spectrum of positive emotions that could have been used as keywords.

Being an individual paper, it was not possible to fulfill the requirement required by the methodology of systematic reviews, namely the use of a minimum of two people to select, preferably individually, the articles for analysis, which may have influenced the evaluation of their selection.

6. Conclusions

Is the Duchenne smile an indicator of positive emotions? In an attempt to answer this question, we selected and analyzed for the narrative systematic review the studies in which the production of Duchenne smiles either took place during the experience of spontaneous positive emotions caused by certain natural life situations, or appeared in during the induction of positive emotions in laboratory or experimental situations. Articles that only investigated the idea of perception and interpretation of these smiles in different contexts without actually producing the Duchenne smile, whether deliberate or not, were removed. On the other hand, some of the present studies did not entirely lack the investigation of Duchenne smile perception, but since measuring the frequency of smile production was one of their themes, they were also taken into analysis.

Based on the results of these studies, we cannot yet draw a clear conclusion regarding the idea that the Duchenne smile is an indisputable indicator of positive emotions, but the data provide us with important information such as the following: Duchenne smile is associated with experiencing positive emotions in general, with those of happiness and joy, in particular. However, the present studies have shown that this time of smiling is also found when emotions such as hope and contentment are experienced.

In addition to their relationship with positive emotions, it was found that although the constriction of the eyes through the activation of the Orbicularis oculi muscle corresponding to the facial action unit AU6 in the FACS coding system is considered a differentiating element between the two types of smiling, however this expression was also encountered in situations where no positive emotions were experienced. Also, it appears that intensity is a better predictor of positive emotions.

The Duchenne smile also appears in the interaction between teachers and students, during which the former provide corrective feedback, increasing the rate of its acceptance by students. On the other hand, the constriction of the eyes is a marker of distress found in both children and adults.

The intensity of the smile must be taken into account in such studies when differentiating between Duchenne and non-Duchenne smiles. Some studies have found in addition to spatial patterns, as considered the Duchenne marker, and temporal properties of emotional expressions that also contribute to the differentiation between a spontaneous and a deliberate smile, being associated with the person's internal states, such as the duration of a smile (Schmidt et al., 2006).

There are authors who recommend that we focus our attention on what a Duchenne smile does rather than what it expresses, without the intention of detracting from the importance of its use for identifying positive emotions, but considering that it is insufficient to evaluate an emotion and label as such (Krumhuber & Kappas, 2022).

To conclude, taking into account all these corroborated results and data from other older studies, we can say that research is still needed to discover the mechanisms underlying these relationships between the Duchenne smile and positive emotions.

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